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TRANSACTIONS.

THE eighteenth meeting of the Kansas Academy of Science was held at Manhattan, in the rooms of the State Agricultural College, on the 10th, 11th and 12th of November, 1885.

The following pages present such transactions relating to the business of the Academy as are of popular interest, together with the papers furnished by their authors, and approved by the Publication Committee.

The committee on securing State geological survey reported as follows:

Your committee beg to report that strenuous efforts were made to secure the passage of a bill providing for a geological survey of the State, by the last Legislature; but their efforts were unsuccessful, although there was much interest manifested in the subject. We would recommend that the effort be continued at the next extra session. There is a popular demand for the work, as well as an economic necessity. Detailed report, copies of bills, circulars, etc., have been deposited with the Secretary.

A. H. THOMPSON, *For the Committee.*

The following persons were elected for one year to the offices named:

President—E. L. Nichols.

Vice Presidents—J. D. Parker, N. S. Goss.

Secretary—E. A. Popenoe.

Treasurer—I. D. Graham.

Curators—F. W. Cragin, N. S. Goss, Geo. S. Chase, E. A. Popenoe, and A. H. Thompson.

Librarian—F. W. Cragin.

The address of the first evening was given by the retiring President, Dr. R. J. Brown, upon "Natural Gas;" and of the second, by Prof. E. L. Nichols, upon "The Magic Lantern: Its History, and its Use in the Sciences."

At the different sessions of the eighteenth meeting the following papers, among others, were read:

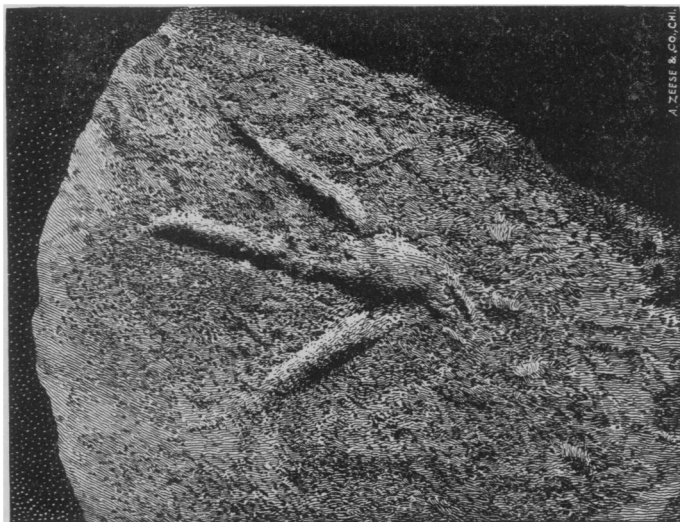
ON THE DISCOVERY OF A FOSSIL BIRD-TRACK IN THE DAKOTA SANDSTONE.

BY PROF. F. H. SNOW, OF THE UNIVERSITY OF KANSAS.

During the past two years Mr. E. P. West has been assisting the writer in the collection of geological specimens for the University cabinets. In the month of August, 1885, he was so fortunate as to discover, near Thompson's creek, in Ellsworth county, Kansas, a single well-marked impression, which I believe to be a genuine bird-track. The piece of rock containing the impression was picked out from a pile of material which had been removed from a well excavation 44 feet in depth. This well was sunk in the Dakota sandstone, and the geological horizon of the bird-track is about 200 feet below the upper level of the Dakota rocks. The horizon of the bird-track appears to be identical with that of a fine series of dicotyledonous leaves obtained on Thompson's creek, at a distance of about a mile and a half from the well.

This impression appears to have been made by the left foot of some bird with

elevated hind toe just reaching the ground at its extremity, as in the modern snipes and other wading-birds, or in the family of sea-gulls and terns. That the track is probably that of a right foot rather than a left, is indicated by the wider separation of the outer toe from the middle toe, resulting from the greater versatility of the outer toe as compared with the inner toe—a character illustrated in many families of existing birds, and carried to an extreme in the cuckoos and the woodpeckers, in which the outer anterior toe is entirely reversed in its direction and becomes a backward-pointing member.



It will be seen from the accompanying cut that our bird-track exhibits the imprint of all four of the toes. The outer anterior toe is represented for fully two-thirds of its length. The middle and inner anterior toes are entirely impressed, even to the claws at their extremities—the claw being very distinctly marked upon the middle toe. The ball of the foot has left a deep impression, and the posterior toe has made an unmistakable imprint upon the sand similar to those made at the present time by birds whose hind toes just reach the ground. That this impression is avian in its character rather than reptilian, is evident from the imprint of the hind toe, for no dinosaur or other reptile, either recent or extinct, is known to have a backwardly directed toe. Some dinosaurs have a fourth small or rudimentary anterior toe, but in no case has a posterior toe been discovered. The absence of the impression of a posterior toe in the so-called bird-tracks of the Connecticut river Triassic sandstone has led the best authorities to consider those tracks reptilian rather than avian. The small size of our Dakota track is a confirmatory indication of its avian character. It measures only two inches from anterior middle claw to claw of posterior toe, being a little larger than the foot of Professor O. C. Marsh's *Ichthyornis victor* as restored by him in his famous monograph of the *Odontornithes*. The restoration of the foot of *Ichthyornis*, however, was based upon a single phalangeal bone, the only portion of the foot yet found, the rest of the skeleton of the foot having been restored in exact imitation of a living species of tern, which among recent birds *Ichthyornis* seems most closely to resemble.

The discovery of this avian footprint in the Dakota rocks considerably lowers the geological horizon of Kansas birds. The Niobrara group of the Cretaceous has hitherto furnished all our knowledge of ancient bird-life in Kansas. From these

rocks was obtained nearly all the material for Marsh's magnificent work upon the "Toothed Birds." This is the highest Cretaceous group represented in Kansas, the Benton and the Dakota lying beneath it. The Dakota rests unconformably upon the Permo-Carboniferous rocks, with apparently an entire exclusion of the Triassic and Jurassic formations. The evidence of the existence of bird-life is thus extended down from the highest to the lowest division of the Kansas Cretaceous, and if Professors Mudge and St. John are correct in maintaining the absence of the Triassic and Jurassic formation in our State, this evidence cannot be extended lower down in Kansas, unless we admit the somewhat improbable suggestion that the class of birds existed in the Paleozoic time.

The discovery of this Dakota bird-track enables us to supply an important element hitherto lacking in that earliest of Cretaceous eras. The wonderful luxuriance of the land vegetation of the Dakota and its marvelous similarity to the dicotyledonous forest growths of the warm temperate climes of the present day, have rendered these sandstone beds a most fascinating field of investigation for both Paleo-botanists and Neo-botanists. The finely developed and perfectly preserved foliage of Oaks, Willows, Poplars, Laurels, Sarsaparillas, Magnolias, Sassafras, and other kindred forms belonging to genera now long extinct, have hitherto suggested a beauty of landscape whose perfection was only marred by the apparent scarcity of animal forms. It is true that these fossil leaves give abundant evidence that the vegetable kingdom was subjected in those ancient times to the attacks of injurious insects. But our imaginations require the presence of more conspicuous animal forms to harmonize with the extremely luxurious development of vegetable life. Our bird-track supplies the missing element of graceful aerial forms. From the size of the footprint it may be safely inferred that the bird which left it was somewhat larger than a pigeon. It was probably a bird with teeth, in that respect resembling its predecessor the European *Archaeopteryx* of Jurassic times and its successors of the Middle Cretaceous, the *Hesperornis* and the *Ichthyornis* of the Niobrara group. If our Dakota bird was an *Ichthyornis*, as is by no means improbable, its habits were doubtless similar to those of the modern Tern.

Prof. Marsh writes of the *Ichthyornis* that "its sharp cutting teeth prove beyond a doubt that it was carnivorous. Its great powers of flight, long jaws, and its recurved teeth, suggest moreover that it captured its prey alive. Its food was probably fishes as their remains are found in great abundance mingled with those of *Ichthyornis*. Besides *Ichthyornis* and its allies, the only other denizens of the air at present known to have inhabited the same region were the toothless Pterodactyls. The *Ichthyornis* doubtless competed with these huge dragons for the fishes in the tropical ocean about which they lived."

The distribution of land and water in Kansas during the formation of the Dakota sandstones was of such a character as to favor the belief that our bird was either a wading-bird, or allied to *Ichthyornis* and the modern Terns. The occurrence of the fossil leaves in restricted areas shows that the land was in the form of islands of limited extent, while the marine character of the fossil shells indicates that these islands were surrounded by a salt-water ocean.

While a student at the Agassiz School of Natural History on Penikese Island off the coast of Massachusetts, the writer took great pleasure in watching the large flocks of Terns which had established their breeding-grounds upon a portion of the island. These beautiful birds, with long and narrow wings, were continually performing their graceful evolutions in the air in search of food in the ocean for themselves and their young. It was a rare occurrence to see these birds alight upon the shores of the island. They consequently left few tracks upon the sand. From "early dawn

to dewy eve" they were incessantly upon the wing, exhibiting a dash and buoyancy of flight unknown to other birds. In the protection of their eggs and young they exhibited unmistakable promptness and valor, swiftly descending along graceful but vigorous curves to a perihelion point in uncomfortable proximity to the face and eyes of the intruding naturalist.

The birds of the Dakota period were doubtless even more active than the Terns of the present day. The probable presence of teeth in their jaws was an advantage evidently employed with disastrous effect not only to the fishes which constituted their food, but also to their rivals and enemies—the flying reptiles without teeth. The latter were overcome in the conflict, and teeth are no longer a necessity to birds.

It is hoped that the discovery of our bird-track may stimulate search for other tracks, and that the evidence for the existence of birds in the Lower Cretaceous may not long depend upon a single "footprint upon the sands of [the Dakota] time."

A GEOLOGICAL SECTION IN WILSON COUNTY, KANSAS.

BY ROBERT HAY, OF JUNCTION CITY, KANSAS.

In April, 1885, the writer was called upon to make some investigations for a coal company in the southeast corner of Greenwood county, and after so doing, spent some time east and south down the Fall river valley, nearly across Wilson county. Some observations were afterward made northwest, about Eureka, but as there was a break in the continuity of the explorations, the last are not noticed in this paper. The general result of the connected observations is the construction of a section parallel with the course of Fall river from the town of that name to a few miles east of Neodesha, in Wilson county. The thicknesses of strata in the western part were obtained by actual measurements both with tape-line and instruments of precision, and the others were carefully estimated from comparisons with the elevations of the San Francisco Railway, kindly supplied by Jas. Dun, Esq., the engineer of the company, and from the actual depth to which the strata have been penetrated by wells, as well as by measurements of precipitous bluffs. In one place a certain stratum was suspected to be merely a local intercalation, a substitute for part of another stratum; but as this could not be satisfactorily determined in the time at my disposal, the stratum was left in its place in the section till further investigation should support or throw out its claim to be considered as an addition to the general thickness of the formations. It does not, however, affect the result to a greater extent than two per cent.

The principal points which the writer would note in connection with this section are, (a) the evidence as to the average dip, and (b) the indications of disturbance of the strata. From Neodesha to Fall River, a distance of twenty-eight miles, the ascent of the Frisco railroad is 124 feet, but these stations are separated geologically by a vertical distance of 405 feet, the former place being situated about on the upper horizon of the Neodesha sandstone, and the latter in a similar position to the Fall River sandstone. This leaves the difference, 280 feet, to be accounted for by the westerly dip, which is therefore about ten feet to the mile. But this average dip, greater than is found in most parts of Kansas, is by no means uniform through the distance surveyed. A carefully measured mile at the western extremity of the section gave a dip of 45 feet, and in a quarry about two miles east of the town of Fall River the sandstone ledges were inclined to the horizon at an angle of more than ten degrees.